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Guidance for the design, commissioning and maintenance of LPG systems in small craft

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 36, an inside back cover and a back cover.

Foreword

Publishing information

This Published Document is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2016. It was prepared by Technical Committee GME/33, *Small craft*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This Published Document supersedes PD 5482-3:2005, which is withdrawn.

Relationship with other publications

This document is a supplement to BS EN ISO 10239:2014, unlike its predecessor, PD 5482-3:2005, which was a stand-alone document. As such, reference might need to be made to BS EN ISO 10239:2014 for more information in certain circumstances, including the fitting of additional appliances or major system modification. However, for design, commissioning and maintenance, this document gives sufficient guidance. If any conflict arises between the two documents, then BS EN ISO 10239:2014 takes precedence.

Information about this document

This is a full revision of the Published Document, and introduces the following principal changes:

- the identifier has been changed to PD 54823, as the Published Document has been revised in such a way that it no longer belongs in the 5482 series;
- the text has been revised to supplement BS EN ISO 10239:2014, concerning the design, commissioning and maintenance of small craft LPG installations;
- gas tightness testing of LPG supply line and appliances has been improved; and
- an annex covering cooking appliances with integral LPG cartridges has been added.

Hazard warnings

WARNING. This Published Document calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

As a guide, this Published Document takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The provisions of this Published Document are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a Published Document cannot confer immunity from legal obligations.

Particular attention is drawn to the Gas Safety (Installation and Use) Regulations [1], [2], [3], [4].

NOTE Guidance on the individual competency for gas work and other guidance regarding legislation is given in the Health and Safety Executive's Approved Code of Practice L56 (ACOP) *[5].*

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1 Scope

This Published Document gives guidance for the design, commissioning and maintenance of LPG (liquefied petroleum gas) systems, including replacement appliances, replacement hose and replacement piping. It covers permanently installed gas burning installations in small craft [1)] of up to 24 m in length, using LPG operating at a nominal pressure of up to 50 mbar [2)]. The LPG is from either cyclinders stowed on board or the on-board aspects of the gas system in the situation of a fixed shore bulk supply.

This Published Document also covers cooking appliances with integral LPG cartridges, for which guidence is given in Annex A.

This Published Document does not cover:

- new system installation requirements as covered in BS EN ISO 10239:2014;
- major system modification for which BS EN ISO 10239:2014 is to be used for installation requirements;
- additional appliances (including additional piping and additional hose) added to an existing system for which BS EN ISO 10239:2014 is to be used for installation requirements;
- on-shore installation of bulk supplies of LPG;
- catering equipment;
- portable LPG-burning appliances not covered in Annex A;
- the installation of LPG generators; or
- the use of LPG for propulsion of vessels for which guidance is given in UKLPG *Code of Practice 18* [6] or BS EN 15609.

NOTE Further information on gas supply systems to permanently moored craft can be found in IGEM/G/6 [7].

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 669 (both parts), *Flexible hoses, end fittings and sockets for gas burning appliances*

BS 1552, *Specification for open bottomed taper plug valves for 1st, 2nd and 3rd family gases up to 200 mbar*

BS 6172, *Specification for installation, servicing and maintenance of domestic gas cooking appliances (2nd and 3rd family gases)*

BS 6362 (ISO 7598), *Specification for stainless steel tubes suitable for screwing in accordance with BS 21 "Pipe threads for tubes and fittings where pressure-tight joints are made on the threads"*

BS 6956 (all parts), *Jointing materials and compounds*

BS 7838, *Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50*

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1) Attention is drawn to the various Merchant Shipping Acts that apply to British registered ships.

2) 1 mbar = 102 N/m^2 = 0.1 kPa = 100 Pa.

BS EN 331, *Manually operated ball valves and closed bottom taper plug valves for gas installations in buildings*

BS EN 449, *Specification for dedicated liquefied petroleum gas appliances – Domestic flueless space heaters (including diffusive catalytic combustion heaters)*

BS EN 549, *Specification for rubber materials for seals and diaphragms for gas appliances and gas equipment*

BS EN 751-2, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water – Part 2: Non-hardening jointing compounds*

BS EN 751-3, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water – Part 3: Unsintered PTFE tapes*

BS EN 1057, *Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating applications*

BS EN 1254-2, *Copper and copper alloys – Plumbing fittings – Part 2: Fittings with compression ends for use with copper tubes*

BS EN 13878, *Leisure accommodation vehicles – Terms and definitions*

BS EN 14291, *Foam producing solutions for leak detection on gas installations*

BS EN 14324, *Brazing – Guidance on the application of brazed joints*

BS EN 15266, *Stainless steel pliable corrugated tubing kits in buildings for gas with an operating pressure up to 0,5 bar*

BS EN 16129:2013, *Pressure regulators, automatic change-over devices, having a maximum regulated pressure of 4 bar, with a maximum capacity of 150 kg/h, associated safety devices and adaptors for butane, propane, and their mixtures*

BS EN 28846, *Small craft – Electrical devices – Protection against ignition of surrounding flammable gases*

BS EN ISO 8434-1:2007, *Metallic tube connections for fluid power and general use – Part 1: 24 degree cone connectors*

BS EN ISO 9094 (all parts), *Small craft – Fire protection*

BS EN ISO 10239:2014, *Small craft – Liquified petroleum gas (LPG) systems*

BS EN ISO 17672, *Brazing – Filler metals*

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation*

3 Terms and definitions

For the purposes of this Published Document, the terms and definitions given in BS EN 13878 and the following apply.

3.1 accessible
capable of being reached for inspection, removal or maintenance, without removal of a permanent vessel structure

NOTE Hatches are not deemed to be permanent vessel structures, even if tools are required to open them.

3.2 additional appliance
appliance that would be an extra appliance to a system

3.3 additional hose
hose required for the fitting of a new appliance

3.4 additional piping
piping required for the fitting of a new appliance

3.5 bourdon gauge
dial-type pressure gauge

NOTE Examples of bourdon gauges are those conforming to BS EN 837-1.

3.6 combustion products discharge safety device
device that causes at least safety shutdown of the main burner when there is an unacceptable spillage of combustion products from the draught diverter of type B_{11BS} water heaters

3.7 conventionally flued instantaneous water heater
water heater of the B_{11BS} type

NOTE A type B_{11BS} is a type B_{11} appliance fitted with a combustion products discharge safety device. A type B_{11} is a natural draught type B_1 appliance. A type B_1 is a type B appliance incorporating a draught diverter. A type B is an appliance intended to be connected to a flue that evacuates the products of combustion to the outside of the room containing the appliance. The combustion air is drawn directly from the room in which the appliance is installed.

3.8 cylinder
portable and refillable vessel of approved design, used to contain LPG under pressure

3.9 cylinder housing
ventilated enclosure intended solely for storage of one or more LPG cylinders, pressure regulation device and safety devices, and located so that leakage flows to the outside

[SOURCE: BS EN ISO 10239:2014, **3.3**]

3.10 cylinder locker
enclosure which is vapour tight to the interior of the craft with a drain to the outside intended solely for storage of one or more LPG cylinders

NOTE The cylinder locker need only be vapour tight to the highest point of the cylinder valve, pressure regulation device or high pressure side components.

3.11 existing system
LPG system installed prior to the implementation of this document

NOTE Annex A of the previous edition of this standard (PD 5482-3:2005) defined an existing system as one which was installed prior to 15 May 1999. This definition also applies.

3.12 flame supervision device
device that has a sensing element, that causes the inlet of the LPG supply to a burner to be opened in the presence of a flame and closed in the absence of a flame

3.13 high pressure side
part of an installation between the cylinder valve and the inlet of a pressure regulation device in an LPG system

NOTE 1 Vapour pressure at 20 °C for propane = 700 kPa and for butane = 175 kPa.

NOTE 2 1 kPa = 10 mBar.

NOTE 3 This was formerly known as the high pressure stage.

3.14 hose
pipeline of flexible material

[SOURCE: BS EN ISO 10239:2014, **3.13**]

3.15 interior space
enclosed space that is surrounded by permanent boat structure and that is intended to remain dry during normal use

[SOURCE: BS EN ISO 10239:2014, **3.6**]

3.16 let-by
internal gas leakage past a shut-off valve seat when fully closed

3.17 liquefied petroleum gas (LPG)
mixture of light hydrocarbons, gaseous under conditions of normal temperature and pressure, and maintained in the liquid state by increase of pressure or lowering of temperature

NOTE 1 The principal components are propane, propene, butanes or butenes.

NOTE 2 LPG can be obtained as commercial butane, commercial propane or a mixture of the two.

[SOURCE: BS EN ISO 10239:2014, **3.1**]

3.18 LPG system
system consisting of an arrangement of cylinder(s), safety device(s), pressure regulation device(s), connection(s), valve(s), piping, tubing, hose, fitting(s) and devices intended to store, supply, monitor or control the flow of LPG up to and including the appliance

NOTE The cylinders are replacement items and might or might not be supplied with the LPG system in the craft.

3.19 low pressure side
part of an installation exposed to the regulated pressure of the LPG pressure regulation device in an LPG system

NOTE This was formerly known as the low pressure stage.

3.20 main shut-off valve
device to isolate the entire LPG system from the high pressure side of the supply

[SOURCE: BS EN ISO 10239:2014, **3.15**]

3.21 major system modification
changes to a system such that the majority of the piping is replaced

3.22 operating pressure
inlet pressure of the LPG appliances

[SOURCE: BS EN ISO 10239:2014, **3.17**]

3.23 permanently installed
securely fastened so that tools need to be used for removal

[SOURCE: BS EN ISO 10239:2014, **3.2**]

3.24 piping
pipeline of rigid metallic material

[SOURCE: BS EN ISO 10239:2014, **3.12**]

3.25 pressure regulation device
device to reduce the high pressure of the LPG system to the required operating pressure of the appliances

NOTE This was formerly known as the low pressure regulator.

3.26 readily accessible
capable of being reached quickly and safely for maintenance or effective use under emergency conditions without the use of tools

[SOURCE: BS EN ISO 10239:2014, **3.7**]

3.27 replacement appliance
appliance that is not an extra appliance to a system

3.28 replacement piping
piping fitted due to maintenance of a system

3.29 room-sealed appliance
appliance with a system in which incoming combustion air and outgoing combustion products pass through sealed ductwork connected to an enclosed combustion chamber and terminating outside the vessel

3.30 shut-off valve
device to isolate an appliance from the gas supply

NOTE This was formerly known as the appliance isolation valve.

3.31 supply control valve
isolating valve immediately upstream of the test section during the tightness test

NOTE This can be the cylinder or tank outlet valve or an intermediate valve depending on the section of pipework to be tested.

3.32 ventilator
device that allows air to pass into and out of an interior space

[SOURCE: BS EN ISO 10239:2014, **3.18**]

4 General

An LPG system and all its components should be capable of withstanding storage at –20 °C to +60 °C.

LPG systems should be of the vapour withdrawal type, i.e. LPG released only under gas phase conditions.

Nominal system pressures in the 28 mbar to 50 mbar range can be found. The pressure regulation system should be designed to provide a fixed nominal pressure suitable for the consuming appliances.

When designing a cylinder installation, the cylinder(s) selected and other supply equipment (e.g. the pressure regulation device) should be of sufficient capacity to ensure safe and satisfactory operation of all appliances simultaneously.

NOTE 1 The gas consumption details for each installed appliance can be found on the appliance data badge.

Table 1 provides guidance on the conversion from heat input to gas rates.

Table 1 **Conversion of heat inputs (kW) to gas rate (kg/h)**

kW	0	1	2	3	4	5	6	7	8	9
0	0.00	0.07	0.15	0.22	0.29	0.37	0.44	0.51	0.58	0.66
10	0.73	0.80	0.88	0.95	1.02	1.10	1.17	1.24	1.31	1.39
20	1.46	1.53	1.61	1.68	1.75	1.83	1.90	1.97	2.04	2.12
30	2.19	2.26	2.34	2.41	2.48	2.56	2.63	2.70	2.77	2.85
40	2.92	2.99	3.07	3.14	3.21	3.29	3.36	3.43	3.50	3.58
50	3.65	3.72	3.80	3.87	3.94	4.02	4.09	4.16	4.23	4.31
60	4.38	4.45	4.53	4.60	4.67	4.75	4.82	4.89	4.96	5.04
70	5.11	5.18	5.26	5.33	5.40	5.48	5.55	5.62	5.69	5.77
80	5.84	5.91	5.99	6.06	6.13	6.21	6.28	6.35	6.42	6.50
90	6.57	6.64	6.72	6.79	6.86	6.94	7.01	7.08	7.15	7.23

NOTE Due to the very similar gas rates of butane and propane and for practical purposes, this table covers both gases.

For a continuous supply, multiple cylinders should be installed. These should be installed in pairs or in banks of cylinders, interconnected via an automatic changeover device that switches gas supply as cylinders empty. Alternatively, they should be directly connected through wall block arrangements.

Table 2 provides recommended off-takes for temperate climates.

Table 2 – Recommended off-takes for temperate climates

Butane			Propane		
Cylinder size	Off-take		Cylinder size	Off-take	
kg	kg/h	kW	kg	kg/h	kW
4.5	0.418	5.75	3.9	0.527	7.39
7	0.487	6.67	6	0.777	11.08
15	0.696	9.45	13	1.054	15.04
–	–	–	19	1.319	18.74

For butane cylinders, satisfactory service might not be obtained at a temperature of less than 10 °C; the most suitable temperature range is from 13 °C to 30 °C. For temperatures lower than 13 °C, the use of propane should be evaluated.

An example calculation for the cylinders needed is shown as follows.

a) Calculate the total heat input in kilowatts of all gas appliances to be supplied by cylinder(s) as follows.

   Cooker 10.0 kW

   Boiler 6 kW

   Total 16.0 kW

   NOTE 2 For cookers, 70% of the maximum gas rate may be used.

b) Convert the kW input to the gas rate (kg/h). For 16 kW the gas rate would be 1.17 kg/h (deduced from Table 1). Alternatively, as 10 kW relates to a cooker, this can be taken as 7 kW, giving 13 kW in total and a gas rate of 0.95 kg/h (deduced from Table 1).

c) Calculate the number of cylinder(s) required. Divide the gas rate by the cylinder off-take rates given in Table 2 and then round up to the next integer.

1) For butane: 1.17 kg/h divided by 0.696 (take-off rate for 15 kg cylinders) = 1.68. Alternatively, based upon a lower cooker rating, 0.95 kg/h divided by 0.696 = 1.36. Hence, in both cases, two 15 kg butane cylinders would be required.

2) For propane: 1.17 kg/h divided by 1.054 (take-off rate for 13 kg cylinders) = 1.11. Alternatively, based upon a lower cooker rating, 0.95 kg/h divided by 1.054 = 0.9. Hence, depending upon the choice of cooker rating either one or two 13 kg propane cylinders would be required.

5 Pressure regulation devices

Replacement pressure regulation and automatic changeover devices should conform to BS EN 16129:2013 and should have an overpressure (OPSO) device, with any discharge inside the cylinder locker or housing, or be separately vented to outside the craft. The pressure regulation device should give a suitable outlet pressure for the installed appliances.

NOTE 1 In existing systems, it is acceptable for the pressure regulation and automatic changeover devices to conform to BS EN 16129:2013, BS 3016, BS EN 12864, BS EN 13785 or BS EN 13786.

NOTE 2 The selection of a pressure regulation and automatic changeover device with a limited relief device can help to prevent nuisance OPSO trips.

Pressure regulation and automatic changeover devices should be located such that the inlet to them is at or above the level of the cylinder outlet valve connection.

Vent holes in pressure regulation devices should be carefully orientated or otherwise protected against the possible ingress of water or substances that could cause blockage, and should also allow for drainage.

The appropriate size of pressure regulation device should be determined according to the maximum gas rate, calculated in accordance with Table 1.

Pressure regulation devices with external manual output pressure adjustment should not be fitted.

Pressure regulation devices marked in imperial units, or more than 10 years old, should be replaced. The date of manufacture should be found on the body or union nut of the device.

High pressure side components should be installed in the same location as the LPG cylinder.

High pressure side components not directly attached to the cylinder valve should be secured in a position that provides protection from mechanical damage or be otherwise protected.

High pressure side components not directly attached to the cylinder valve should be connected by hose. The hose should be of the minimum practicable length to allow replacement of cylinders.

In most circumstances, a high pressure side hose length of no more than 1 m should be sufficient.

6 LPG supply line

6.1 General

Piping and hose should be sized so that any pressure drop due to pipe resistance does not reduce the operating pressure at any appliance below that required by the appliance manufacturer when all appliances are operating simultaneously. See Annex B for guidance on pressure drop due to pipeline resistance.

Piping and hose sizing should be designed to ensure a pressure drop due to pipe resistance does not exceed 2 mbar from the outlet of the pressure regulation device to the inlet of each appliance, with all appliances running.

NOTE For an existing system, a pressure drop with all appliances running in excess of 2 mbar is accepted, provided that the pressure at any appliance does not drop below the minimum pressure of appliance given in Table H.1.

6.2 Piping

All additional piping should be installed in accordance with BS EN ISO 10239:2014.

The following should be used for replacement piping:

a) seamless copper tube conforming to BS EN 1057;

NOTE 1 Copper tube conforming to BS EN 12449 is equivalent to that conforming to BS EN 1057.

b) rigid stainless steel tube conforming to BS 6362;

c) pliable corrugated (stainless steel) tubing (PCT) conforming to BS 7838; and

d) copper nickel alloy, of a grade suitable for use with LPG and a marine environment (for existing systems only).

Except for PCT, wall thickness for piping should be equal to or greater than 0.6 mm for piping up to 12 mm outside diameter, and a minimum of 0.9 mm for piping greater than 12 mm outside diameter.

Care should be taken to ensure that PVC does not come into contact with exposed stainless steel, owing to the risk of corrosion.

The following materials should not be used for piping for the reasons given:

1) aluminium (due to corrosion, low melting point, vibration);

2) lead (due to creep);

3) brass tubing (due to season cracking);

4) non-stainless steel tubing, e.g. mild steel, cast iron (due to corrosion);

5) plastics (due to low melting point, low-temperature embrittlement); and

6) tubing of the type fabricated from sheet steel, coated internally and externally and wrapped (due to atmospheric corrosion).

Fittings for connections and joints in piping should be metallic and of any of the following types:

i) hard soldered, brazed or welded connections. Brazed connections should be made in accordance with BS EN 14324 using BS EN ISO 17672 filler metals. The melting point of materials at hard soldered, welded or brazed connections should not be less than 450 °C;

ii) cutting ring fittings in accordance with BS EN ISO 8434-1:2007, Table 4;

iii) copper rings on copper piping; stainless steel rings on stainless steel piping;

iv) compression fittings on copper or copper alloy piping in accordance with BS EN 1254-2 or equivalent, with annealed copper olives;

v) compression fittings on stainless steel piping made of stainless steel conforming to BS 6362;

vi) pressure regulation device connections in accordance with BS EN 16129:2013, Annex G and Annex H;

vii) pliable corrugated (stainless steel) tubing (PCT) fittings in accordance with BS EN 15266 or BS 7838, or equivalent;

viii) bayonet or self-sealing connector hose fittings conforming to BS 669 (both parts) and installed in accordance with BS 6172; and

NOTE 2 A bayonet or self-sealing connector hose fitting is not deemed to be a shut-off valve for appliance isolation.

ix) threaded connections conforming to ISO 7-1.

Jointing compound for flared fittings or flared rings and gas tightness by compression of ductile joints (except pressure regulation device connections in accordance with BS EN 16129:2013) should not be used.

Jointing compounds should conform to BS 6956 (all parts) or BS EN 751-2 and should only be applied to tapered male threads of components. Jointing compounds should not be used for compression fittings.

Washers or gaskets should conform to BS EN 549 or be of a material suitable for use with LPG, i.e. it should be durable, robust and gas tight. Fibre washers and hemp should not be used.

PTFE (Polytetrafluoroethylene) tape should conform to BS EN 751-3 and should be used in accordance with the manufacturer's instructions.

Joints and fittings should be readily accessible.

NOTE 3 In existing systems, the final connection to the appliance may be accessible.

In existing systems, bulkhead fittings in the LPG supply line are permitted in engine compartments.

NOTE 4 In existing systems installed before 15 May 1999, joints and fittings in LPG supply lines are permitted in diesel engine compartments.

Where piping is no longer required, the piping should be disconnected as close to the point of supply as practicable. All piping ends should be properly sealed, e.g. with a stop end.

WARNING. Do not use shut-off valves to isolate an open end pipe from the LPG system, even if the open end is only temporary, such as when an appliance is removed for servicing.

During any work that necessitates connection or disconnection of any piping, where appropriate, a temporary electrical continuity bonding connector should be fixed securely to the piping. The safe isolation of any 230 v a.c. electrical system should be ensured prior to working on the LPG installation.

6.3 Hoses and hose lines

All additional hose should be installed in accordance with BS EN ISO 10239:2014.

Materials and components of replacement hose assemblies should be designed and suitable for LPG to withstand the stresses and exposures found in the marine environment.

NOTE 1 There is no fixed replacement date for hose, unless specified by the appliance manufacturer or marked upon the hose.

The following hoses listed are suitable for LPG to withstand the stresses and exposures found in the marine environment:

a) Type 2 of BS 3212:1991;

b) Class 3 of BS EN 16436-1:2014;

c) Class 2 of BS EN 16436-1:2014 for low pressure side only;

d) BS EN ISO 10380 stainless steel hose for high pressure side only; and

e) assemblies conforming to BS 669 (both parts) for cooker connections only, provided that they are marked to identify their suitability for LPG applications and are installed in accordance with the appliance manufacturer's installation instructions.

NOTE 2 A bayonet or self-sealing connector may be used for cooking appliances using a hose which conforms to BS 669.

Hoses should not be routed through an engine compartment.

Hoses should be of minimum practical length.

NOTE 3 For non-all-hose systems, a maximum hose length of 1 m is sufficient.

Hoses should have permanently attached end fittings, such as swaged sleeve or sleeve and threaded insert. Hoses on the low pressure side may be secured to nozzles by a metal crimped clip or a worm drive hose clamp.

Hoses and hose connections should be readily accessible.

NOTE 4 In existing systems, the final connection to the appliance may be accessible.

Hoses should be installed so as to avoid stress or tight radius turns, and hose connections should be stress free, i.e. not subjected to tension or kinking under any conditions of use.

Where an all-hose system is used for the LPG low pressure supply line, the hose should be continuous and have no joints or fittings from within the cylinder locker or cylinder housing to the appliances, or the readily accessible shut-off valve near the appliance.

Where a metallic supply piping system is used it may be connected to a flexible hose leading to an appliance.

NOTE 5 Attention is drawn to the Gas Safety (Installation and Use) Regulations [1], [2], [3], [4] under which some appliances on vessels might be required to be connected with rigid metal piping.

6.4 Materials

Fittings through which LPG flows should be compatible with LPG and be galvanically compatible with the metallic piping to which they are connected.

Hose clamps should be made of corrosion-resistant material and be reusable. Hose clamps fixed by spring tension should not be used. Hose clips and clamps should be of the correct size for the hose.

End connecting fittings should be of corrosion-resistant material, such as brass or stainless steel, or be of equivalent corrosion resistance in a marine environment.

Where cutting ring fittings are used in conjunction with copper piping, a brass insertion sleeve and brass cutting ring should be fitted. All components should be matched.

Lubricants used in valves upstream of appliances should be of a type suitable for use with LPG, e.g. lubricants having a 25% molybdenum disulfide base.

6.5 Installation

Piping should not have direct contact with metallic parts of the craft structure of higher nobility than the piping.

LPG supply lines should be supported in order to prevent damage from chafing or vibration. For piping, such fixing devices should be spaced at intervals not exceeding 0.5 m; for hoses, the intervals should not exceed 1 m.

Fixing devices should be corrosion-resistant, non-abrasive, designed to prevent cutting or other damage to the lines and galvanically compatible with the supply line material. In the case of conduit it should be vented and if metallic then of higher nobility than the piping.

All joints should have at least one fixing device per line not more than 150 mm away from the joint. Joints secured by proprietary integral fixings such as mounting plates or bulkhead fittings can be deemed to have met this recommendation.

All joints and connections in piping and hose in the LPG system should be made such that no undue stress is created at the fitting.

Piping and hoses passing through bulkheads intended to maintain watertight integrity in the craft at the level of penetration should be sealed by materials or fittings capable of maintaining the water tightness.

Piping and hoses should be protected from abrasion or chafing at the point where they pass through walls or bulkheads.

6.6 Shut-off valves

Each LPG system should be equipped with a singular readily accessible manually operated main shut-off valve to isolate the low pressure side from the high pressure side. The main shut-off valve can be the cylinder valve or it can be connected to the pressure regulation device or incorporated in the pressure regulation device. Where there is no cylinder valve and the pressure regulation device is directly connected to the cylinder, the incorporated valve to the pressure regulation device can be a main shut-off valve as long as its action isolates the cylinder contents from the pressure regulation device input and removal of the pressure regulation device from the cylinder closes the cylinder valve.

NOTE 1 In existing systems, the main shut-off valve might be outside the accommodation area in the low pressure side piping. In existing systems installed before 15 May 1999, the main shut-off valve might be within the accommodation area.

In existing systems, where there is more than one main shut-off valve, the location of all other main shut-off valves should be marked adjacent to each main shut-off valve.

A dual or multiple cylinder LPG system should be provided with non-return valves in the pressure regulation device or in the high pressure side hoses, in addition to each cylinder shut-off valve, to prevent the escape of LPG when any cylinder is disconnected.

A shut-off valve should be installed in the low pressure supply line to each appliance. The valve or its control should be readily accessible and operable from within the vicinity of the appliance, and operable without reaching over the top of open flame appliances such as stoves. If there is only one appliance in the LPG system and the main shut-off valve at the cylinder is readily accessible from the vicinity of the appliance, the shut-off valve on the low pressure supply line is not required. A solenoid valve located on the high or low pressure side of the pressure regulation device, operable from the vicinity of the appliance, is deemed to have met this recommendation. Solenoid valves should be closed in cases of lack of tension, i.e. loss of electrical actuating energy.

NOTE 2 For appliances installed in existing systems before 15 May 1999, only those connected with a hose need be fitted with a shut-off valve.

For shut-off valves which are not located immediately adjacent to the appliance that they control, a means of identifying the appliance controlled should be provided. If a valve is not visible, its location should be clearly indicated by means of a visible and permanent marked label secured in place.

Taper plug type valves should be spring loaded and may be used only in the low pressure side of the LPG system. Taper plug valves should conform to BS 1552.

Shut-off valves should be located such that inadvertent or accidental operation is avoided.

Needle valves should not be used as shut-off valves in the low pressure side of the LPG system. Gate valves should not be used as shut-off valves.

Ball valves should conform to BS EN 331.

7 Appliances

Any additional appliance should be installed in accordance with BS EN ISO 10239:2014.

Any replacement appliance should meet the appliance requirements of BS EN ISO 10239:2014.

NOTE 1 For appliances installed in existing systems before 15 May 1999, non-room-sealed flued appliances that do not meet the requirements of BS EN ISO 10239:2014 might be found.

Appliances should not be installed in petrol engine spaces, unless in accordance with the manufacturer's instructions.

NOTE 2 Appliances installed in existing systems before 15 May 1999 might be installed in diesel engine spaces and may remain so, provided this is in accordance with the manufacturer's instructions.

Where it is not possible to replace an instantaneous water heater incorporating a flue with a draught diverter, or unflued, with an appliance meeting the requirements of BS EN ISO 10239:2014:

a) one conventionally flued instantaneous water heater, type B_{11BS}, with a maximum input rate not exceeding 11.6 kW, fitted with a combustion products discharge safety device may be installed; and

b) the installer should carry out and record an assessment of any risk associated with the replacement appliance.

NOTE 3 Due to the danger of carbon monoxide poisoning, it is essential that any conventionally flued appliance and/or its combustion air supply does not communicate with any room/cabin containing a bath or shower.

Water piped to an instantaneous water heater inlet should directly originate from the cold water system of the vessel.

For systems containing a non-room-sealed LPG refrigerator installed in vessels propelled by a petrol engine:

1) the pilot lights and burners should be completely enclosed; and

2) the combustion air and combustion products should be drawn and exhausted through a suitable flame trap, through combustion air piped to the appliance from outside the vessel, from a point inside the vessel above the level of the windows, other openings, or other means of ventilation, in the interior space; and

3) only the flue supplied or recommended by the manufacturer should be used with refrigerators flued to the outside.

For systems containing a catalytic type appliance, these appliances should conform to BS EN 449, including the existence of a flame supervision device and the provision of a fire guard on the appliance.

NOTE 4 It is also acceptable for these systems to conform to BS 5258-11.

Each LPG burning appliance should be securely fixed to the craft so as to eliminate undue stress on piping, hose and fittings.

Each LPG burning appliance, including lamps, should be equipped with a flame supervision device for each burner and pilot light.

NOTE 5 For appliances installed in existing systems before 15 May 1999, only catalytic type appliances or appliances with a pilot light or appliances with a continuous flame designed to be left unattended with burners operating continuously need be fitted with a flame supervision device.

In existing systems, wood, curtains and other combustible materials near to appliances should be insulated or treated with a flame retardant as appropriate. Such items should not be within the locality of appliance burners for other systems.

In circumstances where the adjacent surfaces to an appliance show signs of overheating, preventative measures should be taken. Guidance for fire protection is available in BS EN ISO 9094 (all parts).

For cooking appliances, a permanent, legible warning label, with a minimum character height of 4 mm, should be affixed in a conspicuous position on or adjacent to the appliance (cooking stove or oven). This label should provide at least the following information, in a language acceptable in the country of intended use:

DANGER. Avoid asphyxiation. Provide ventilation when the stove is in use. Do not use for space heating.

NOTE 6 The label is not required if permanent unrestricted ventilation, as recommended in Annex C, is provided for all the appliances within the accommodation area.

For flued appliances, a permanent, legible warning label, with a minimum character height of 4 mm, should be affixed in a conspicuous position on or adjacent to the appliance. This label should provide at least the following information, in a language acceptable in the country of intended use:

DANGER. Avoid asphyxiation. Provide ventilation when the heater is in use.

NOTE 7 The label is not required if permanent unrestricted ventilation, as recommended in Annex C, is provided for all the appliances within the accommodation area.

8 Location and installation of LPG cylinders

Cylinders should be stored upright with the valve uppermost.

Any replacement cylinder locker or cylinder housing should meet the requirements of BS EN ISO 10239:2014.

NOTE 1 It is suggested when designing a cylinder locker or housing that it is constructed from material with at least the equivalent fire resistance of the surrounding vessel structure. BS 476-20 provides guidance on fire resistance of materials or alternatively, a cylinder locker or housing could be of metal of at least 0.9 mm thickness with welded or brazed joints, or of fibre reinforced plastics (FRP) of at least 5 mm thickness.

Cylinder locker openings should be located outside accommodation, engine, fuel or battery spaces.

NOTE 2 In existing systems installed before 15 May 1999, cylinder locker openings may be located in a low risk position outside engine, fuel or battery spaces.

In existing systems, LPG cylinders, if not in a cylinder locker, may be situated in self-draining cockpits if:

a) the cockpit drain outlets are above the deepest loaded waterline;

b) the cockpit is LPG tight to the interior of the vessel (including to the height of any bridge deck or fixed cill to an interior space), at least to the level of the cylinder, pressure regulation device and associated equipment; and

c) hatches or openings in the cockpit are watertight.

In existing systems, LPG cylinders and pressure regulation devices may be situated on open deck, on cabin tops, or outside cockpits, provided they are at least 0.5 m from hatches and other hull openings to the interior space, at least 0.5 m from any source of ignition so that any leakage flows overboard.

Side opening cylinder lockers should have an effective seal which is LPG tight when the door is closed. If the seal is not effective, the side opening cylinder locker should be treated as a cylinder housing or the LPG cylinder not in a cylinder locker.

All hoses or piping penetrating cylinder locker walls should be sealed at the wall so as to maintain vapour tightness to the craft interior.

NOTE 3 Hoses or metal piping may exit the top of a cylinder locker, or above the required vapour tight height, without the need for a vapour tight seal.

Cylinder lockers should not contain any loose components that could damage the cylinder, pressure regulation device, piping or hose installation, or obstruct the locker drain.

Cylinders, valves and pressure regulation devices should be installed so that they are readily accessible.

NOTE 4 Cylinders, valves and pressure regulation devices may be located in lockable cylinder lockers or cylinder housings, provided these are unlocked when the system is in use.

The opening into a cylinder locker should enable operation of valves, replacement of cylinders and access to connections or regulating devices.

Cylinder locker lids or covers should be maintained, to protect items within the cylinder locker from mechanical damage.

Repairs to a cylinder locker should be made using materials of at least an equivalent fire resistance to the original locker and such that the locker is vapour tight to the interior of the vessel when repaired.

Cylinder locker (or housing) drain pipes and hoses should be of a material suitable for LPG to withstand the stresses and exposures found in the marine environment (for example, those suitable for petroleum products), with any securing clips corrosion resistant. Any drain piping or hose should be continuous and fall to the external connection.

Cylinder locker, and cylinder housing, drains should have an internal diameter of at least 19 mm.

In existing systems installed before 15 May 1999, cylinder lockers for cylinders up to 15 kg total capacity should be provided with a drain at least 12 mm in internal diameter, and cylinder lockers for cylinders with a total capacity greater than 15 kg should be provided with a proportionately larger drain.

9 Ventilation

Ventilation should be provided in accommodation spaces where flued or unflued appliances are used or to which compartments containing such appliances are connected by open passageways. The design of ventilation should take into account the air consumption of the appliances and occupants of the spaces, and allow outside air to pass through fixed openings.

Minimums for sizing and locations of ventilation openings are given in Annex C.

NOTE The area of fixed ventilation given by the equation in Annex C is the minimum needed to secure efficient distribution of fresh air.

10 LPG installation tightness tests

10.1 Principle

Tests to ensure gas tightness should be carried out:

a) before gas charging and commissioning of all newly-installed pipework, or additions to pipework;

b) whenever any work is carried out on an installation that might affect tightness;

c) if a gas escape is suspected, or if there is a smell of gas; and

d) before re-establishing an existing gas supply.

A tightness test as given in **10.2** should be carried out for the low pressure supply line only, comprising a test with air with appliances disconnected or isolated. This test should generally used for newly-installed pipework, or extensions to existing pipework.

A high pressure side test as given in **10.3** should be carried out for all installations.

A tightness test as given in Annex D comprises a test of the supply line including LPG appliances, using LPG as the test medium, and should be carried out on all installations.

Only proprietary leak detection fluids (LDFs) that conform to BS EN 14291 should be used and these should be compatible with the materials to which they are to be applied. LDFs containing more than 30 parts per million of halogens should not be used on stainless steel components.

To avoid subsequent corrosion, care should be taken to ensure that LDF is wiped off pipe and fittings after use.

CAUTION. Do not use detection fluid containing ammonia. Ammonia, which is present in some soaps and detergents, attacks brass fittings. Although damage is undetectable at first, brass fittings might crack and leak within a matter of months after contact with ammonia.

10.2 Test method for tightness testing of the low pressure supply line only, with appliances disconnected or isolated at the shut-off valve and before gas charging

10.2.1 General

The low pressure supply line pipework should be tested as tight to ensure there is no discernible pressure drop.

NOTE 1 This procedure is based on testing with a pressure gauge for pressure loss in the low pressure only, and is usually the most practical method. However, alternative procedures are possible. Low pressure supply line tightness is expected to meet the "no discernible pressure drop" criterion based on the use of a "U" gauge (low pressure) or a bourdon gauge (intermediate pressure). These procedures therefore refer to the use of these gauges but more sensitive instruments might be substituted.

NOTE 2 A pressure drop of 0.25 mbar or less on a "U" gauge is considered not discernible. Where "no discernible pressure drop" is needed for the tightness test of low pressure supply line alone, using a "U" gauge, 0.25 mbar is therefore still an acceptable pressure drop if measured by more sensitive instruments such as an electronic/digital gauge providing they are regularly re-calibrated.

10.2.2 Calibration

All "U" gauges should be calibrated in accordance with the manufacturer's instructions.

10.2.3 Preparation

Use air as the test medium. Cap or plug all open points in the system except for the one that is to be used to admit air to the system.

10.2.4 Procedure for low pressure supply line

Carry out the following stages.

a) Ensure that gas appliances are disconnected or are positively isolated by closing their shut-off valve. Cap or plug all open ends.

b) Connect an in-line test tee. Check the zero on a "U" gauge and connect the "U" gauge to the test tee.

c) Inject air or an inert gas into the system until the "U" gauge registers at least three times the nominal operating pressure, i.e. 111 mbar for a propane system with a nominal system pressure of 37 mbar. Do not exceed 150 mbar.

d) Isolate the pressurizing source.

e) Leave for at least 5 min to allow the temperature in the system to stabilize.

f) Note the "U" gauge reading.

g) Leave for 5 min.

h) Note the "U" gauge reading. The pipework is considered tight if there is no discernible pressure drop from that of f), but if a discernible drop is observed, continue to i). With no discernible pressure drop the test is complete, the air can be released and the test equipment removed (unless it is to be immediately used to conduct commission testing [see Annex D]).

i) If the pressure has fallen, examine the entire installation and check each joint with LDF to locate the source of leakage.

j) Eliminate the leak and repeat the procedure from c) until the installation is proved tight and no discernible pressure drop is recorded.

10.2.5 Commission testing

Once the entire pipework system has been proved tight under air in accordance with this procedure, appliances can be connected or turned on at their shut-off valves, the system purged of air and charged with LPG in preparation for a tightness test under LPG pressure (see Annex D).

10.3 Test method for tightness testing of the high pressure side

10.3.1 Preparation

Use LPG as the test medium. Ensure a tightness test has been successfully conducted, as described in **10.2** or in Annex D, before undertaking this test.

10.3.2 Procedure for high pressure side

Carry out the following stages.

a) Ensure that gas appliances are connected and that the LPG low pressure supply line is tight.

b) Connect all cylinders to the high pressure side. Ensure that any main shut-off valve, if not the cylinder valve, is on.

c) Turn on every cylinder.

d) Apply LDF to the high pressure side components.

e) Immediately watch the tested components for at least 2 min to allow the LDF to show signs of leakage.

f) The high pressure side is deemed to be tight if there are no signs of bubbling to the LDF or there is no smell of gas, but if bubbling is observed or there is a smell of gas, continue to g). With no bubbling or smell of gas the test is complete, the cylinders should be shut-off and any gas safely released from the system.

g) If bubbling is observed or there is a smell of gas, locate the source of leakage.

h) Eliminate the leak and repeat the procedure from a) until the high pressure side is proved tight.

11 Electrical devices for ignition sources

There should be no potential sources of ignition or electrical joints in cylinder lockers or housings.

If electrical devices are located in cylinder lockers or housings, the equipment should be ignition protected in accordance with BS EN 28846.

Electrical cables not required for the operation of equipment in a cylinder locker or housing should not pass through a cylinder locker or cylinder housing, unless contained within a conduit gas tight to the locker or housing.

12 Owner's manual

For any replacement appliance, the gas engineer should provide to the LPG system user instructions supplied by the appliance manufacturers and guidance on emergency procedures and safe usage.

Guidance on emergency procedures and safe usage is given in Annex E.

13 Ducts and flues for air intake and combustion product discharge

Any replacement duct or flue should meet the requirements of BS EN ISO 10239:2014.

The flue system and air intake duct system should each be continuous and sealed to be vapour tight from the appliance to its terminal outside the craft.

The entire flue system should be capable of being reached for inspection, removal or maintenance without removal of a permanent craft structure.

Flue terminals should be of substantial construction or provided with guards sufficient to prevent damage by accidental contact. Such guards should also be placed on exhaust discharge outlets also prevent injury from contact with hot surfaces.

Flue terminals should not be positioned within 500 mm of a refuelling point or fuel tank breather outlet or any ventilator outlet from the fuel system(s).

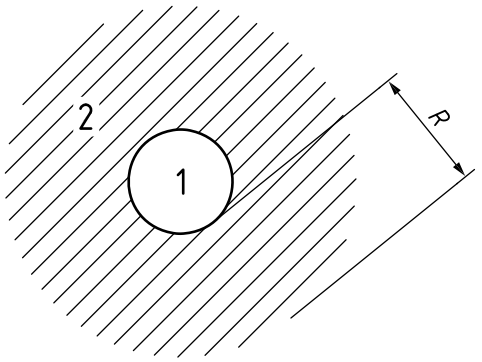
*NOTE 1 A refuelling point, breather outlet or ventilator outlet is not a reference to LPG cylinders. LPG cylinders location is covered in Clause **8**.*

NOTE 2 In existing systems installed before 15 May 1999, flue terminals may be positioned closer than within 500 mm of a refuelling point or fuel tank breather outlet or any ventilator outlet from the fuel system(s).

Flue terminals should not be located within 300 mm of a ventilator, opening port, hatch, window for the living space or an opening part of a window (see Figure 1).

NOTE 3 In existing systems installed before 15 May 1999, flue terminals may be positioned closer than within 300 mm of a ventilator, opening port, hatch, window for the living space or an opening part of a window.

Figure 1 **Ventilators: prohibited zone for discharge openings for the products of combustion**



Key

1 Ventilator, opening port, hatch or window

2 Prohibited zone for discharge opening for the products of combustion $R \geq 300$ mm

Appliances designed for use with a flue should have a flue fitted. Flues should be of the type approved by the manufacturer, and should be properly fitted and maintained. Flues should be of suitable material, effectively insulated, and of appropriate internal diameter to ensure safe transfer of gases to outside the vessel, away from areas that could be enclosed by canopies. For appliances installed in existing systems before 15 May 1999, those designed for use with a draught diverter and flue should have these fitted.

NOTE 4 Some examples of appliances designed for use with a flue are: multipoint instantaneous water heaters, single point instantaneous water heaters for shower or bath, any appliance fitted with a flue spigot.

Flues with a draught diverter within the flue system should be tested to establish flue performance. A test of flue performance for an appliance with a draught diverter is given in Annex F.

14 Commissioning and maintenance tests

A suitable connection point for test equipment should be provided to verify the tightness of the LPG system, to test system pressure and to test the performance of the pressure regulation device.

For ease of system testing, preference should be made to a test point in the piping between the pressure regulation device and the appliance shut-off valve(s), but close to the furthest appliance shut-off valve from the pressure regulation device.

The LPG system should be tested as follows.

WARNING. Do not use a naked flame for any testing.

a) Test the low pressure side for gas tightness in accordance with Annex D. If a bubble tester is to be used, test in accordance with the bubble tester manufacturer's instructions or in accordance with Annex G.

b) Test high pressure side in accordance with **10.3**.

c) Commission any newly installed appliances in accordance with the manufacturer's recommendations.

d) Test the pressure regulation device and appliance operating pressure in accordance with Annex H.

e) Visually check for a correct flame picture at each burner with all appliances operating at the maximum rate.

f) Check the function of all flame supervision devices.

g) Check the condition of all hoses.

h) Check the condition of any flue pipes and the flue performance of any appliance flue incorporating a draught diverter in accordance with Annex F.

i) Check the condition of any cylinder locker to ensure required vapour tightness.

j) Verify that the ventilation is in accordance with Annex C.

Annex A Cooking appliances with integral LPG cartridges with a capacity of 225 g or less

Only cooking appliances suitable for use with LPG in a marine environment should be installed and fitted in accordance with the manufacturer's instructions. The proximity and flammability of materials in relation to appliances should conform to BS EN ISO 9094 (all parts).

Cooking appliances with integral LPG cartridges and intended for use in the accommodation area should have not more than 225 g of attached LPG capacity. Only one cartridge may be in use at a time and should incorporate a self-closing device to enable its removal for storage when not in use. The owner's manual should instruct the operator to remove and to replace cartridges in the open air and away from sources of ignition.

The cooking appliance should be designed to ensure that only LPG vapour reaches the burner and it should be capable of normal operation under the conditions specified in this annex. Extinguishment of the flame or leakage of LPG should constitute failure to meet this recommendation.

Operating controls should be readily accessible, and located to minimize possible injury from burners or elements when being used.

Burner controls should be equipped or designed to require two-stage operation when going from the "off" to "on" position to prevent unintentional or accidental opening of valves during handling and storage.

Appliances designed with continuously burning pilot lights should be prohibited.

Cooking appliances with integral LPG cartridges and in use should have a positive means of mechanical retention and be secured. Means should be provided on or adjacent to stove top cooking surfaces to prevent both deep and shallow cooking pans from sliding across or off the stove during craft motion, at pitch angles up to 15°, or roll angles up to 30° for monohull sailing craft, 15° angles of pitch or roll for engine driven craft and multihull sailing craft. Alternatively, guidance should be provided to use the cooking appliance only when safe to do so.

Cooking appliances with integral LPG cartridges, when not in use, and any reserve or empty cartridges should be stored either in a cylinder locker or on the boat exterior, protected from the weather and mechanical damage, and where escaping vapours can only flow towards the outside.

Printed instructions should be provided with each cooking appliance and should include information on:

a) proper installation, location for use and storage;

b) storage of in-use and reserve cartridges; and

c) the appliance manufacturer's instructions on operation, maintenance and changing LPG cartridges.

Annex B Design guidelines for pressure drop due to pipe resistance

Piping and hose should be sized so that any pressure drop due to pipe resistance does not reduce the operating pressure at any appliance below that required by the appliance manufacturer when all appliances are operating simultaneously. See Table B.1 for guidance on pressure drop due to pipeline resistance.

Table B.1 **Pressure drop due to pipeline resistance**

Piping or hose inside diameter	Pressure drop per metre of pipe for appliances of output										
	1 kW	2 kW	3 kW	4 kW	6 kW	8 kW	10 kW	12 kW	15 kW	20 kW	25 kW
mm	mbar	mbar	mbar	mbar	mbar	mbar	mbar	mbar	mbar	mbar	mbar
4	0.04	0.15	0.3	0.5	1.5	2.3	–	–	–	–	–
6	0.01	0.04	0.07	0.12	0.03	0.4	0.7	1.0	1.4	2.6	–
8	<0.01	0.01	0.02	0.03	0.01	0.15	0.2	0.25	0.4	0.7	1.1
10	–	<0.01	<0.01	0.01	0.03	0.04	0.06	0.09	0.13	0.22	0.32
15	–	–	–	<0.01	0.01	0.01	0.02	0.02	0.04	0.06	0.1
22	–	–	–	–	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.01

NOTE 1 This table is for system pressures – propane: 30 mbar, 37 mbar and 50 mbar; and butane: 30 mbar and 50 mbar.

NOTE 2 Equivalent lengths of pipe for fittings are: elbow or tee 0.6; straight coupler 0.3; hose or pipe bend 0.3.

NOTE 3 The smallest pipe diameter practicable is to be used.

Annex C Area of fixed ventilation

The effective area of fixed ventilation for accommodation spaces containing an LPG appliance, V, in mm^2, should be calculated from the following equation:

$$V = 2\,200U + 650P + 440F + 550H$$

where:

U is the input rating of unflued appliances, in kilowatts (kW);

P is the number of persons for which the accommodation space is designed;

F is the input rating for all open flued appliances, in kilowatts (kW); and

H is the nominal output rating of solid fuel appliances, in kilowatts (kW), as defined in BS 8511:2010.

NOTE 1 This formula applies to any accommodation space in the craft containing flued or unflued LPG appliances that can be closed off.

The minimum sizing of ventilation should take account of any other air consuming appliances in the accommodation space burning other types of carbon fuels.

The minimum effective area, A, of fixed ventilation is 4 000 mm^2.

NOTE 2 Screening or louvres over ventilation openings reduce effective area by approximately 50%, or more if the wire or bar size exceeds the opening dimensions between, and needs to be accounted for.

NOTE 3 For ventilation calculation purposes, curtaining is not deemed to be an adequate means to close off an accommodation space.

Ventilation should be supplied by at least two equally sized fixed openings in the accommodation space, with one opening as high as practicable and one as low as practicable. Both openings should be positioned or shielded such that they cannot be inadvertently obstructed.

NOTE 4 The fixed ventilation may be divided as equally as practicable between high and low level, by singular or multiple ventilators.

Where ventilation air is ducted to a space from an outside source, the duct cross-sectional area should be maintained throughout its length, the duct should be securely fixed and accessible for inspection, and the duct should not have forms that can trap liquids.

Ventilation systems passing through engine spaces for appliances and accommodation areas should be avoided.

Adjustable ventilation provided by openable windows, roof lights or hatches should not be included in the calculation.

Ventilators that have variable settings should only be included in the calculations at their lowest optional rating.

Ventilation should be provided through, or around, cockpit coverings over an area leading to a fixed ventilator, equivalent at least to the size of the fixed ventilator.

Ventilation systems should be designed to avoid draughts.

Non-room-sealed flued appliances in closed compartments (e.g. cupboards) should have ventilation at both high and low level as recommended by the appliance manufacturer. Room-sealed appliances installed in closed compartments (e.g. cupboards) should have adequate ventilation to prevent overheating as recommended by the appliance manufacturer. Where no manufacturer's instructions are available, then ventilation in accordance with Table C.1 should be provided.

Table C.1 **Minimum air vent free area for closed compartment (mm² per kW of appliance maximum net input)**

Appliance type	Compartment ventilated	High level vent (mm² per kW)	Low level vent (mm² per kW)
Room-sealed	to room or internal space	1 000	1 000
	direct to outside air	500	500
Flued	to room or internal space	1 000	2 000
	direct to outside air	500	1 000

Annex D Testing of the LPG supply line and appliances

D.1 Purging the supply line

Every new or modified supply line should be purged of air after satisfactorily passing the tightness test (see Clause **10**) and being connected to the LPG supply.

During the purging operation, LPG should not be allowed to accumulate in any confined space. Steps should be taken within the vicinity of the purge point to ensure good ventilation, to prevent inadvertent operation of any electric switch or appliance and to prohibit smoking or naked flames.

D.2 Gas tightness testing of LPG supply line and appliances

D.2.1 General

The supply line should be tested as tight to ensure there is no discernible pressure drop. The permitted maximum leak rates and equivalent pressure drops for typical installations given in Table D.1 should be followed.

NOTE 1 These procedures are based on testing with a pressure gauge for pressure loss in the pipework and appliance system when under pressure with all inlets and outlets sealed. This is usually the most practical method. However, alternative procedures are possible. Pipework tightness is expected to meet the "no discernible pressure drop" criterion based on the use of a "U" gauge (low pressure) or a bourdon gauge (intermediate pressure). These procedures therefore refer to the use of these gauges but more sensitive instruments might be substituted.

NOTE 2 Gas appliances, for practical reasons, are allowed a very small leakage, which can occasionally create a discernible pressure drop when complete installations are tested particularly if the pipework and appliance internal volume is small.

NOTE 3 A pressure drop of 0.25 mbar or less on a "U" gauge is considered not discernible. Where "no discernible pressure drop" is needed for the tightness test of pipework alone using a "U" gauge, 0.25 mbar is therefore still an acceptable pressure drop if measured by more sensitive instruments such as an electronic/digital gauge providing they are regularly recalibrated.

Table D.1 **Permissible pressure drop for test with appliances connected and LPG supplied by cylinder(s) or bulk tank installation pipework**

Volume of installation [A] m^3	**Number of appliances installed**	**Permissible pressure drop**	
		Initial test pressure	
		37 mbar	28–30 mbar
		Pressure drop in 2 min mbar	
More than 0.001	3+	2.0	2.0
	2	1.5	1.5
	1	1.0	1.0
Less than 0.001	3+	4.0	3.0
	2	3.0	2.0
	1	1.5	1.0

[A] The system volume can be calculated but, as a guide, if the system is piped in 15 mm pipe or larger and/or the appliances are distributed throughout a boat of large size, then the volume is likely to be at the top end of the range. Where the pipework is all small diameter and the appliances are installed in a compact space then the volume is likely to be low.

As a further guide, a 2 m length of 8 mm copper pipe has a volume of approximately 0.000 06 m^3, a 2 m length of 10 mm copper pipe has a volume of approximately 0.000 1 m^3 and the same length of 15 mm pipe a volume of approximately 0.000 3 m^3.

D.2.2 Calibration

All "U" gauges should be calibrated in accordance with the manufacturer's instructions.

D.2.3 Principle

This procedure tests the entire supply line from supply control valve up to and including the appliances. The procedure is suitable for all cylinder and tank installations.

The procedure tests the system including the appliances, but it is permissible to test the supply line only first if this is seen as more convenient.

D.2.4 Preparation

Identify the LPG supply control valve for the section to be tested. This might be the main shut-off valve or a separate valve or the cylinder valve(s) or the tank valve.

On cookers with a fold-down lid, the lid should be raised to a fully open position during the tightness test so that any safety shut-off valves on the supply to the cooker are open.

D.2.5 Procedure

Carry out the following stages.

a) Close the supply control valve and all appliance burner control taps. Ensure that all shut-off valves are open. Using an appliance burner, burn off any remaining gas in the pipework where the test tee is installed or to be installed.

b) Locate a permanent in-line test tee or where necessary fit a suitable test tee in the piping for this purpose. Check the zero on a "U" gauge and connect the "U" gauge to the test tee.

c) Perform the following test.

1) Gradually open the supply control valve until the pressure regulation device locks up. Record the "U" gauge reading of the lock up pressure.

2) Close the supply control valve.

3) Light a burner on one appliance. If there are no high pressure hoses fitted in the supply line under test, reduce the pressure by around 5 mbar. If there are high-pressure hoses in the supply line being tested, allow the pressure to fall until there is a sudden increase in the dropping rate and then immediately close the appliance burner control tap: the pressure at which this occurs varies, but is generally around 30 mbar propane or 20 mbar butane. If testing the supply line only, then isolate the appliances from the test tee section. Record immediately the "U" gauge reading.

NOTE 1 The lowering of the pressure is necessary to ensure that the locked up pressure in any hoses is released so as not to potentially hide system leakage.

NOTE 2 If there is an under pressure shut-off (UPSO) downstream of the supply control valve, this might close as the pressure falls. In this case, once the pressure has been reduced, operate the UPSO reset to release the trapped upstream pressure and then allow it to reshut. There might be a small sudden rise in the "U" gauge reading as the upstream pressure is released into the downstream pipework.

4) Wait for at least 5 min for temperature stabilization and when the reading is stable record the "U" gauge reading. If the pressure falls within the stabilization period immediately record the "U" gauge reading and move on to 5). If the pressure rises without stabilizing, or has risen to the lock up pressure, go to d).

5) Wait a further 2 min and again record the "U" gauge reading.

6) If there is no discernable pressure drop with all shut-off valves open, move on to f). If there is a discernable drop, go to e).

NOTE 3 If the procedure in Note 2 has been necessary, the UPSO reset might need to be operated again after the 2 min period, and before recording the second "U" gauge reading.

d) If the pressure rises, this might indicate either:

1) the gas temperature has risen during the test. If this is suspected, repeat the test procedure from c) 3);

2) the supply control valve is letting-by. If this is suspected, repeat the entire test having operated the supply control valve several times to clear a fault or use a replacement supply control valve; or

3) for cylinder installations using high-pressure hose(s) between the cylinder valve(s) and pressure regulation device where the cylinder valve(s) is the supply control valve, a rise in pressure is due to hose relaxation. If this is suspected, install an additional supply control valve downstream of the high-pressure hose(s). Repeat the entire test. This valve may be left in place once the tightness test is completed.

e) If a discernible pressure drop occurs or there is a smell of gas:

1) Isolate the appliances by closing their shut-off valves and repeat c). This tests just the supply line and only a no discernible pressure drop is acceptable (see **D.2.1**). If a discernible pressure drop or its equivalent leak rate still persists or there is a smell of gas after repeating c), leak test all visible joints with LDF or a suitable gas detector and repair as necessary. Repeat c). Once acceptable move on to d) 2).

NOTE 4 For this test, the test tee needs to be in the pipework section under test.

2) After proving the supply line tight, repeat c) with shut-off valves open to include the appliances. A pressure drop is acceptable provided it does not exceed the values given in Table D.1 for the relevant type of installation and there is no smell of gas.

NOTE 5 Appliance standards for practical reasons permit a very small leakage, which can cause the pressure drop observed in the first test particularly if the internal volume of pipework and appliances is small.

3) If the system pressure drop exceeds that permitted, repeat c) but with only one shut-off valve open and repeat for each appliance in turn to check if the cause is one particular appliance. Rectify the fault(s) if possible, or seek advice from the appliance manufacturer(s). Repeat c) to prove the installation acceptable.

f) Light a burner on one appliance and allow the pressure to drop to about half the pressure used in c). Immediately close the appliance burner control tap. Record immediately the "U" gauge reading.

NOTE 6 If there is an under pressure shut-off (UPSO) downstream of the supply control valve, this might close as the pressure falls. In this case, once the pressure has been reduced, operate the UPSO reset to release the trapped upstream pressure and then allow it to reshut. There might be a small sudden rise in the "U" gauge reading as the upstream pressure is released into the downstream pipework.

g) Wait a further 2 min and again record the "U" gauge reading.

NOTE 7 If the procedure in Note 6 has been necessary, the UPSO reset needs to be operated again after the 2 min period, and before recording the second "U" gauge reading.

1) If there is no discernible pressure rise, "no let-by" can be recorded for the supply control valve. If the pressure rises go to d).

2) If there is no discernable pressure drop with all shut-off valves open, move on to h). If there is a discernable drop, go to e).

h) After proving the installation acceptable, if conducting a pressure regulation device and appliance operating pressure test, follow the procedure in Annex H. Otherwise, release the system pressure by lighting a burner. Remove the "U" gauge and replace the screw to the test tee.

i) Re-establish the gas supply by opening the supply control valve. Test the test tee with suitable leak detection fluid or a suitable gas detector. Rectify leaks if found.

Annex E Information and instructions for emergency procedures and safe usage

E.1 General

When an LPG system is installed in a craft, the installer should provide an owner's manual containing instructions for its correct operation and maintenance, including user instructions supplied by equipment and appliance manufacturers. General requirements for owner's manuals are set out in BS EN ISO 10240 and details of instructions to include relating to LPG systems are shown in BS EN ISO 10239:2014.

Where a replacement appliance is fitted, the gas engineer should provide instructions for its correct operation and maintenance, including user instructions supplied by the appliance manufacturers.

The following safety information represents good practice advice that can be passed on by gas engineers to customers.

E.2 Emergency procedures

E.2.1 Leakage

If LPG leakage is detected or suspected, the following action should be taken immediately:

a) shut off the LPG supply at the cylinder valve(s);

b) extinguish naked flames and other ignition sources (heaters, cooking appliances, pilot lights, cigarettes, etc.);

c) do not operate electric switches;

d) ventilate the area with a through draught; and

e) evacuate the area if possible.

If leakage is from a cylinder and cannot be stopped, move the cylinder to where LPG can disperse away from the vessel (and other vessels). Take care not to spill LPG while moving the cylinder.

Do not use an installation that has leaked until it has been checked by a competent person.

E.2.2 Fire from an LPG leak

If an LPG leak has ignited, action should be taken in accordance with a) or b) as appropriate.

a) If the vessel is moored:

   1) alert everyone in the area and evacuate if possible;

   2) call the fire brigade if practicable;

   3) do not attempt to extinguish any flame unless it is safe to do so. Shut off the LPG supply before attempting to extinguish the flame. After shutting off the LPG supply, extinguish any free burning materials with extinguishers or water; and

   4) do not reuse the installation until it has been checked by a competent person.

b) If the vessel is offshore:

   1) alert everyone on the vessel;

   2) if it is safe to do so, shut off the gas supply;

   3) extinguish any free burning materials with extinguishers or water; and

   4) do not reuse the installation until it has been checked by a competent person.

E.2.3 Fire close to an LPG cylinder

WARNING. LPG cylinders exposed to fire can explode.

If there is a fire close to an LPG cylinder, the following action should be taken:

a) alert everyone in the area and evacuate if possible;

b) call the fire brigade if practicable;

c) if it is safe to do so, shut off the gas supply and move the cylinder to a safe place in the open. If the cylinder cannot be moved, keep it cool with wet blankets and spraying with water; and

d) do not reuse the installation until it has been checked by a competent person.

E.3 Safe usage

The following safe practices should be followed when changing a cylinder.

a) Ensure that any manually operated valves on both the full and empty cylinder are turned off before changing. Replace the plastics safety cap or plug on disconnected cylinders.

b) Store, transport and use cylinders vertically with the valve uppermost.

c) Do not use a cylinder if the cylinder, valve or regulator are damaged. Return the cylinder to the supplier. Do not attempt to repair the fault.

d) Before changing a cylinder, extinguish any fire, flame or source of ignition, including cigarettes and pilot lights.

e) Joints should be firm and gas tight. If a leak is suspected after changing a cylinder and opening the valve, check the cylinder valve with an ammonia-free LDF. Do not use a naked flame for testing.

f) If a leak cannot be stopped, move the cylinder to a safe place in the open, ensuring that the leaking LPG is dispersed safely.

g) Ensure that replacement cylinders are appropriate for the installation.

h) Ensure that the regulator is appropriate for the appliances, and use in accordance with the manufacturer's recommendations.

i) Ensure that sealing washers, if required, are sound and correctly positioned prior to connecting. Mating surfaces of connections that require metal-to-metal sealing should be clean and undamaged. Do not use damaged valves or connections.

j) Use the correct size of spanner for connections, and tighten firmly. Self-sealing valves should be connected in accordance with the manufacturer's recommendations.

k) Regulators fitted with integral relief valves should be ventilated to the open, away from sources of ignition.

l) Ensure that all appliance taps are turned off before reconnecting cylinders that have been closed, or connecting replacements.

m) Light appliances without an ignition device by applying a match or taper to the burner before turning on the supply.

E.4 Refuelling petrol, diesel or LPG powered vessels

As well as taking normal precautions against spillage, smoking or naked flames when refuelling petrol, diesel or LPG powered vessels, ensure that all gas burners are turned off, and permanent pilot lights extinguished. Disable automatic ignition systems on appliances while refuelling.

E.5 Appliance usage

The following should be adhered to when using appliances.

a) Operation and maintenance of appliances should be carried out in accordance with the manufacturer's recommendations.

b) Ventilate the area. Do not obstruct ventilator openings. Do not use cooking appliances to heat the area.

WARNING. Non-room-sealed fuel-burning appliances consume oxygen and can release combustion products into the vessel.

c) Check flexible hoses regularly. Replace if cracked or otherwise deteriorated. Ensure that the ends of replacement flexible hoses are secure and gas tight.

d) Ensure that the LPG system is regularly tested for leakage. Connections should be checked by:

1) routine observation of a bubble tester; or

2) routine observation of a pressure gauge in the high-pressure side of the system; or

3) testing with leak detection fluid, with the appliance burners turned off and the main shut-off valve open.

WARNING. If there is a leak discovered in the LPG system, close the cylinder valve and ensure that it is repaired by a competent person.
Do not use solutions containing ammonia to detect leaks.
Do not check for leaks with a naked flame.

e) Check flue pipes at least once per year and replace as appropriate.

f) Check the cylinder locker is not damaged such as to allow the escape of leaked LPG. Check the cylinder locker drain is not blocked or damaged. For side opening cylinder lockers, check the effectiveness of any seal.

Annex F Test of flue performance for an appliance flue incorporating a draught diverter

LPG appliance flues fitted with a draught diverter should be tested to ensure the flue is effective, as follows.

a) Check that the flue is not obstructed by foreign matter, the flue terminal is undamaged and the appliance is operating at the correct pressure.

b) Close doors, windows and any closable ventilators, and operate any fan that could adversely affect the performance of the flue. (If there is a fan in an adjoining space, this should be operated, with connecting doors open.)

c) Operate the appliance and check that it clears the products of combustion, either in accordance with the manufacturer's recommendations, or in accordance with d).

d) If there are no manufacturer's recommendations available for testing the flue, perform a flow visualization check using a smoke producing device (e.g. smoke match, puffer or joss-stick) that produces an even trace so that the flow can be observed, as follows.

   1) Check the flue performance at the draught diverter or gas fire canopy, within 5 min of lighting the appliance. All smoke, apart from the odd wisp, which may be discounted, should be drawn into the flue and removed to the outside air.

   2) If smoke spillage occurs, leave the appliance operating for a further 10 min and recheck.

e) If an appliance fails the flue test, it should be disconnected from the gas supply.

NOTE If there is adequate ventilation provided, an appliance can fail the flue spillage test due to insufficient length of flue. In this case, a proprietary flue extension may be considered or, alternatively, a flue extraction fan with flow failure safeguards, or replacement of the appliance.

Annex G LPG system tightness test using a bubble tester

G.1 General

The test in this annex is for use with a bubble tester and it does not require breaking into the LPG system.

The test only identifies leakage and does not measure any pressures. For testing pressures, refer to Annex H.

If the bubble tester manufacturer's instructions for use are available, these should be followed in preference to the test in this annex.

G.2 Principle

When an operator presses and holds down the test button to the bubble tester, the LPG supply line passes through fluid within the bubble tester. If, downstream of the bubble tester, an appliance burner is lit or there is leakage, then LPG passes through the fluid and is seen as bubbles.

G.3 Preparation

A bubble tester needs to be permanently installed in the low pressure side of the LPG system, as close to the pressure regulation device as possible. Where the pressure regulation device is fitted in cylinder locker or cylinder housing then the bubble tester should also be fitted in the same locker or housing.

NOTE Bubble testers may be fitted on a by-pass arrangement, where the bubble tester is installed in piping parallel to the main LPG supply line with a valve in the supply line that can be closed when using the bubble tester. This minimizes the pressure drop due to the restriction of the bubble tester when the tester is not in use.

G.4 Procedure

Carry out the following stages.

a) Locate the bubble tester.

b) Ensure all gas appliance control valves (taps) are closed but all appliance shut-off valves are open.

c) Open the main shut-off valve (if fitted) and the cylinder valve(s).

d) If a bubble tester bypass arrangement is fitted, ensure the valves are set to allow flow through the bubble tester.

e) Check all joints and connections between the cylinder valves(s) and the bubble tester with LDF. If any leakage is apparent, turn off the cylinder valve(s) and rectify the fault.

CAUTION. Do not use LDF containing ammonia. Ammonia, which is present in some soaps and detergents, attacks brass fittings. Although damage is undetectable at first, brass fittings might crack and leak within a matter of months after contact with ammonia.

f) Light a low-flow burner to an appliance on the LPG system (e.g. on a hob).

g) On the bubble tester, press down the test button and hold it down in this "test" mode for at least 10 s.

h) Observe the bubble tester for bubbles in the clear fluid chamber indicating that the tester is functioning.

i) Turn off the low-flow burner.

j) If no bubbles appear, rectify the fault and repeat the test. No bubbles might be due to no fluid in the fluid chamber or the bubble tester being installed incorrectly or a faulty bubble tester.

k) If bubbles appeared in the bubble tester, press down the test button and hold it down in this "test" mode for at least 60 s.

l) Observe the bubble tester, and if bubbles are visible in the fluid chamber at this stage the LPG system is not LPG tight. Turn off the cylinder valve(s), rectify the fault and repeat the test.

m) If when observing the bubble tester, no bubbles were visible, this indicates that the system downstream of the bubble tester is LPG tight.

n) If a bubble tester by-pass arrangement is fitted, return the by-pass arrangement to original position.

o) Turn off the cylinder valve(s).

Annex H Testing pressure regulation device and appliance operating pressure

H.1 General

The test in this annex should be carried out on installations only after satisfactory testing in accordance with Annex D.

Check the nominal operating pressure and gas group of the appliance (this normally appears on the data plate on the appliance). Appliances with the imperial markings 110 (butane) or 140 (propane) are at least 30 years old and should be replaced.

NOTE 1 The operating pressure is usually 28 mbar (sometimes 28 mbar to 30 mbar) for butane appliances, and 37 mbar (or 30 mbar to 37 mbar) for propane. Appliances installed in craft manufactured in the USA or Germany can differ.

NOTE 2 The code G30 is sometimes used for butane and G31 for propane.

Check and record the standard in accordance with which the pressure regulation device is manufactured.

Check the nominal outlet pressure of the pressure regulation device and ensure that it is compatible with the inlet pressure of the appliance. Pressure regulation devices marked in imperial units, or more than 10 years old (check the date of manufacture on the body or union nut) should be replaced.

H.2 Calibration

All "U" gauges should be calibrated in accordance with the manufacturer's instructions.

H.3 Principle

This procedure tests the system pressures due to a combination of the pressure regulation device and the supply line resistance. The procedure is suitable for all cylinder and tank installations.

The procedure requires all the appliances to be connected and in working order.

H.4 Preparation

If an appliance does not have a pressure test tee, a test tee should be installed adjacent to the appliance inlet.

Open fully any closed ventilators for the duration of the test.

H.5 Procedure

Carry out the following test using the appliance inlet pressure test tee for each appliance.

a) Close the main shut-off valve and all appliance burner control taps. Ensure that all shut-off valves are open. Using an appliance burner, burn-off any remaining gas in the supply line where the test tee is installed.

b) Check the zero on a "U" gauge and connect it to the test tee.

c) Turn on the main shut-off valve (and cylinder or tank if a separate valve). Light one appliance burner and then turn off. Record the stable lock-up pressure. If a stable lock-up pressure is not recorded within 60 s of the appliance burner being turned off, then the pressure regulation device should be replaced. This lock-up pressure should not exceed the permissible deviation for the standard to which the pressure regulation device was manufactured. See Table H.1 for detail on pressure regulation device operating pressures as extracted from the relevant standards.

d) Ignite one burner at maximum rate. Observe and record the working pressure. Check the reading against the permissible deviation for the standard to which the pressure regulation device was manufactured. See Table H.1 for detail on pressure regulation device operating pressures as extracted from the relevant standards.

Table H.1 **Extract from standards showing pressure characteristics of various pressure regulation devices**

Pressure regulation device standard and type (all set pressures)	Nominal outlet pressure	Minimum outlet pressure	Maximum outlet pressure	Maximum lock-up pressure	OPSO operating pressure
LPG type	mbar	mbar	mbar	mbar	mbar
BS 3016 Single stage				Above set pressure:	
Butane	28	23	33	+10	
Propane	37	32	42	+15	–
BS 3016 Final (second) stage				Above set pressure:	
Propane	37	32	42	+10	70–80
BS 3016 Automatic changeover				Above set pressure:	
Propane	37	32	42	+15	70–80
BS EN 12864 Single stage					All ±20%
Butane	29	22	35	40	150
LPG [A)]	29	27	35	40	150
LPG [A)] ("LAV" type) [B)]	30	30	35	40	150
Propane	37	27	45	50	150
Butane or Propane or LPG [A)]	50	47.5	57.5	62.5	150
BS EN 13785 Single stage BS EN 13786 Automatic changeover					
Butane	29	22	35	40	58–150
LPG [A)]	29	27	35	40	58–150
LPG [A)] ("LAV" type) [B)]	30	30	35	40	58–150
Propane	37	27	45	50	74–150
Butane or Propane or LPG [A)]	50	47.5	57.5	62.5	150–150
BS EN 16129:2013 Single stage and Automatic changeover [C)]					All ±15%
Butane	29	22	35	40	48–150
LPG [A)]	29	27	35	40	48–150
LPG [A)] ("LAV" type) [B)]	30	30	35	40	48–150
Propane	30	27	35	40	48–150
Propane	37	27	45	50	60–150
Butane or Propane or LPG [A)]	50	47.5	57.5	62.5	75–150

[A)] LPG shown in this table is a mixture of butane and propane.
[B)] LAV type regulators are designed to conform to BS EN 1949 for use in a LAV (Leisure Accommodation Vehicle), e.g. caravan or motor caravan.
[C)] For installations where final pressures are specified by BS EN 437.

e) Turn on and ignite all the remaining gas burners to produce the maximum gas load.

f) Observe and record the operating pressure. Check that the operating pressure is not below the minimum value recommended by the appliance manufacturers or, in the absence of such information, then as shown in Table H.2. If below an acceptable level, identify the cause, which could be the pressure regulation device or the size of the supply line.

g) Turn off all burners and main shut-off valve. Light one burner to remove any gas in the supply line and then turn off. Disconnect "U" gauge from the test tee and reseal it. Turn on the gas supply and check the gas tightness of the test tee with suitable leak detection fluid or a suitable gas detector. Rectify leaks if found.

Table H.2 **Operating pressures**

Gas	**Group** [A)]	**Nominal pressure of appliance** [B)]	**Minimum pressure of appliance** [C)]
mbar	mbar	mbar	mbar
Butane (G30)	Cat I3+ }	28	20
	Cat I3B }	28–30	20
	Cat I3B/P (30)	30	25
	Cat I3B/P (50)	50	42.5
Propane (G31)	Cat I3+ }	37	25
	Cat I3B/P (30)	30	25
	Cat I3B/P (50)	50	42.5

[A)] Gas group is a national identifier identifying local gas pressures within the EU. Countries using the Groups I3B/P generally do not have separate butane and propane gas bottles and utilize instead a mixed gas in a single cylinder containing a gas blend that varies seasonally.

[B)] This is the pressure normally expected with a single appliance burner operating although this can vary slightly due to manufacturing settings.

[C)] The minimum pressure figures are the lowest pressures at which appliances are recognized to operate safely. Performance is likely to be affected.

Bibliography

Standards publications

BS 476-20, *Fire tests on building materials and structures – Part 20: Method for determination of the fire resistance of elements of construction (general principles)*

BS 3016 (withdrawn), *Specification for pressure regulators for liquefied petroleum gases*

BS 3212:1991, *Specification for flexible rubber tubing, rubber hose and rubber hose assemblies for use in LPG vapour phase and LPG/air installations*

BS 5258-11 (withdrawn), *Specification for safety of domestic gas appliances – Part 11: Flueless catalytic combustion heaters (3rd family gases)*

BS 8511:2010, *Code of practice for the installation of solid fuel heating and cooking appliances in small craft*

BS EN 437, *Tests gases – Test pressures – Appliance categories*

BS EN 837-1, *Pressure gauges – Part 1: Bourdon tube pressure gauges – Dimensions, metrology, requirements and testing*

BS EN 1949, *Specification for the installation of LPG systems for habitation purposes in leisure accommodation vehicles and accommodation purposes in other vehicles*

BS EN 12449, *Copper and copper alloys – Seamless, round tubes for general purposes*

BS EN 12864, *Low-pressure, non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures*

BS EN 13785, *Regulators with a capacity of up to and including 100 kg/h, having a maximum nominal outlet pressure of up to and including 4 bar, other than those covered by EN 12864 and their associated safety devices for butane, propane or their mixtures*

BS EN 13786, *Automatic change-over valves having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures*

BS EN 15609, *LPG equipment and accessories – LPG propulsion systems for boats, yachts and other craft*

BS EN 16436-1:2014, *Rubber and plastics hoses, tubing and assemblies for use with propane and butane and their mixture in the vapour phase – Part 1: Hoses and tubings*

BS EN ISO 10240, *Small craft – Owner's manual*

BS EN ISO 10380, *Pipework – Corrugated metal hoses and hose assemblies*

Other publications

[1] GREAT BRITAIN. The Gas Safety (Installation and Use) Regulations 1998. London: The Stationery Office.

[2] NORTHERN IRELAND. The Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004. Belfast: The Stationery Office.

[3] GREAT BRITAIN AND ISLE OF MAN. The Gas Safety (Installation and Use) Regulations 1994, as amended and applied by The Gas Safety (Application) (Isle of Man) Order 1996. London: The Stationery Office.

[4] GUERNSEY. Health and Safety (Gas) (Guernsey) Ordinance 2006.

[5] HEALTH AND SAFETY EXECUTIVE. *Safety in the installation and use of gas systems and appliances – Approved Code of Practice and guidance L56.* (Fourth edition) London: HSE Books, 2013.

[6] UKLPG. *Code of Practice 18 – Safe use of LPG as a propulsion fuel for boats, yachts and other craft*. Kenilworth: UKLPG, 2003.

[7] INSTITUTION OF GAS ENGINEERS AND MANAGERS. *IGEM/G/6 – Gas supplies to mobile dwellings.* Loughborough: IGEM.

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